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PRESCRIBED BURNING

in the Pine Regions of Southern New Jersey and Eastern Shore Maryland

A SUMMARY OF PRESENT KNOWLEDGE

by S. Little and H. A. Somes

STATION PAPER NO. 151 • NORTHEASTERN FOREST EXPERIMENT STATION • 1961
U.S. FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE • UPPER DARBY, PA.
RALPH W. MARQUIS, DIRECTOR

This Station Paper is a slightly enlarged version of an article that appeared in the Northeastern Forest Experiment Station's Annual Report for 1959. Because of the considerable interest that has been expressed in this subject, this information is being published as a separate so that it may be available to more people than receive the Annual Report.

PRESCRIBED BURNING

in the Pine Regions of Southern New Jersey and Eastern Shore Maryland—

A SUMMARY OF PRESENT KNOWLEDGE

by S. Little and H. A. Somes

About the Authors . . .

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HORACE A. SOMES *graduated from the Pennsylvania State College Ranger School in 1932. After brief employment in one of the New Jersey state forests, he was a foreman in the Civilian Conservation Corps until 1942. Since then, except for military service in World War II, he has been a forestry aide at the Northeastern Station's New Lisbon research center, where he has been closely associated with Dr. Little in his researches into uses of prescribed burning.*

PRESCRIBED BURNING

TWENTY YEARS ago the deliberate use of fire in forest management was frowned upon by many foresters. Many heated arguments developed over it, even though ecological studies had shown that fire favored the maintenance of several valuable forest types. Today attitudes have changed: most foresters accept fire as one of their management tools — though admittedly it is dangerous and is applicable only in certain areas.

In the Northeast, prescribed burning has been extensively tried only in two pine regions of the Atlantic Coastal Plain: southern New Jersey and the Eastern Shore of Maryland. Eight years ago, a summary of experience with prescribed burning in the two regions up to that time was reported *(3)*. Since then, observations on the earlier studies have been continued, and several new studies have been established. This report is, again, a summary of experience; it reviews, as of today, what has been learned about using fire in the forests of these two regions.

DIFFERENCES BETWEEN REGIONS

The pine regions of southern New Jersey and the Eastern Shore of Maryland differ markedly in predominant pine species, in soil-site conditions, in forest productivity and values, and in past and present types of land use.

In the Pine Region of southern New Jersey, pitch and shortleaf are the predominant pine species. Loblolly and pond pines are confined mostly to part of Cape May County, and Virginia pine is found chiefly along the edges of the region.

Several conditions make for an acute wildfire problem. Soils are sandy, and in many places they are excessively drained so that forest floors dry very rapidly. There are few cultivated fields to break the large expanses of woodland. However, since the region is near metropolitan centers, and has numerous sites suitable for artificial lakes, recreational use is increasing and more and more permanent residences are being built in wooded areas. This type of intensified use accentuates the wildfire problem; but, on the other hand, it also leads to greater interest among local landowners and residents in forest practices that will reduce the risks of devastating wildfires.

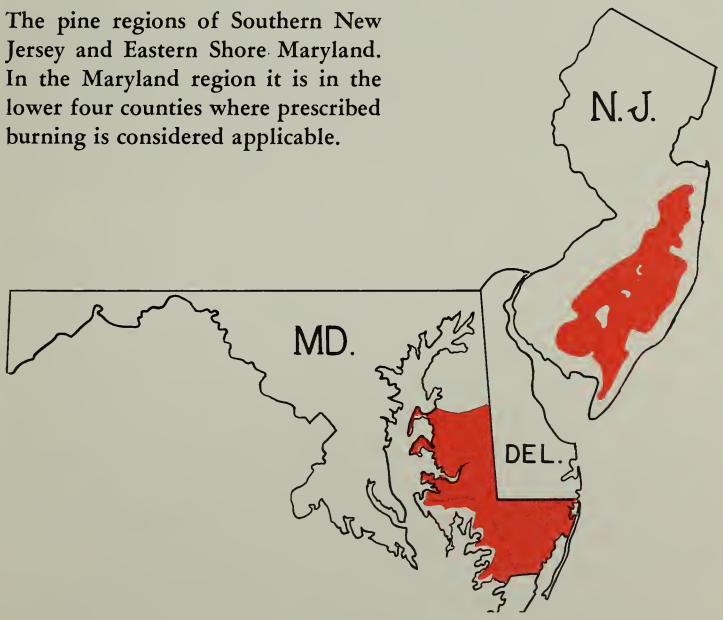
Landowners need relatively cheap methods of forest management, and for sound reasons: first, because site productivity is low (site indexes for pine at 50 years mostly range from 50 to 65 feet) and second, because stands of good composition and quality are rare. There are very few old-field stands of pure or almost pure pine, and nearly all wooded areas have been cut and burned so repeatedly that present growth is far less than the capacity of the sites. Financial returns consequently are low — usually $20 to $30 an acre from a heavy cutting, as compared to a possible $300 to $400 from good stands.

The Maryland Eastern Shore region presents a striking contrast. Here the predominant pine species is loblolly, and pond pine is second in abundance. Shortleaf and Virginia pines are minor spe-

cies. Many of the sites are poorly drained and forest floors dry slowly, and much of the forest land is interspersed with cultivated fields. Because of these conditions, wildfires are not such a serious problem that prescribed burning to reduce forest fuels is a necessary protective measure.

Most Eastern Shore sites are highly productive: site indexes for pine commonly range from 75 to 90 feet at 50 years. Stumpage values are high, especially for the predominantly pine stands of old-field origin, which are fairly common in the region. On one of our study areas, for example — a 41-acre stand about 53 years old — the stumpage brought $837 an acre in 1958, and this did not include previous light cuttings for piling and pulpwood.

Because of the highly productive sites, foresters can choose among several tools and procedures in forest management. Planting, silvicides, disking, and bulldozing can be used in place of fire, or to supplement it. Costs of $20 to $50 an acre for establishing a desirable forest stand are not considered prohibitive.



The pine regions of Southern New Jersey and Eastern Shore Maryland. In the Maryland region it is in the lower four counties where prescribed burning is considered applicable.

NEW JERSEY PINE REGION
SILVICULTURE

Oak-Pine Stands

Oak-pine stands in New Jersey commonly comprise mixtures of tree oaks (black, white, and chestnut oaks) and pitch and shortleaf pines. Such stands were the subject of our first studies in prescribed burning. Under proper conditions, prescribed winter fires can be used periodically in these stands to reduce fuels without appreciably affecting current yields — *if* the crop trees are larger than 2 inches d.b.h. *(9, 16)*. Of course, the larger the trees, the easier it is to prescribe-burn without undue damage.

Periodic winter burning creates favorable seedbeds for the establishment of pine seedlings (fig. 1). Once pitch and shortleaf pine seedlings have developed their characteristic basal crooks, most of them can survive subsequent fires by sprouting from basal buds *(13)*. Consequently, under periodic burns, the amount of pine reproduction tends to increase, particularly in the more open stands. Frequently a combination of shelterwood cutting and periodic burning can be used effectively to favor the establishment of advance pine reproduction. Since both pitch and shortleaf pine seedlings sprout vigorously after injury, losses among this reproduction during logging often are unimportant *(10)*.

The amount of pine reproduction present after cutting may increase in proportion to the number of burns before cutting: in two studies this increase was roughly 500 seedlings per acre per burn *(3)*. Where overstory trees are old enough that relatively few stumps sprout, cutting after periodic winter burning may result in replacement of a predominantly oak stand by a stand composed predominantly of pine (fig. 1). Through manipulation of burning and cutting to take advantage of good seed crops, foresters can almost guarantee successful conversion in such situations.

Of course, where young oaks are cut and sprouting is vigorous, successful conversion to pine will not occur unless silvicides or

other measures are used to control the hardwoods *(3)*. Advance pine reproduction will compete with vigorous hardwood sprouts far more successfully than seedlings starting after the cutting, but even advance reproduction cannot predominate in the next crop without some help *(11)*.

Pine-Scrub Oak Stands

Pine-scrub oak stands (fig. 2) pose a more difficult management problem than oak-pine mixtures, chiefly for three reasons. (1) Comparatively small amounts of pine seed are distributed because most of the pines are pitch pines of the type that holds its seed indefinitely in closed cones. (2) Bear oak, the most common oak species, provides far more competition to pine reproduction, and is more difficult to control with cuttings or silvicides, than the tree oaks. (3) The average site is drier than in oak-pine stands, making the establishment and survival of pine reproduction more uncertain.

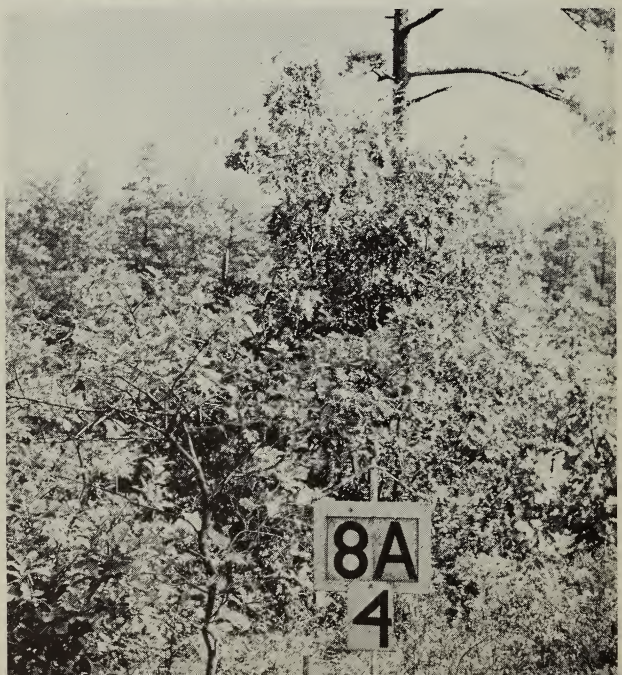
Light winter fires consequently have produced less favorable results than in oak-pine stands. Generally fewer pine seedlings start, or if good stocking is initially obtained, drought may eliminate a high proportion. The mortality from drought is, of course, greater on the sandier soils, as was demonstrated in one study where 81 percent of the pine seedlings on Lakewood and Lakehurst sand soils died during a very dry summer in their second year, compared to a seedling loss of 55 percent on a loamier Sassafras soil *(6)*. With favorable weather, prescribed burning for seedbed preparation, possibly supplemented by direct seeding and brush-hogging, can provide the desired reproduction, but release from scrub oak competition still will be needed.

Some of the answers for managing these stands probably will be provided by current studies, among which are: (1) a study of periodic winter burns, seed-tree cutting, and other measures in an area with a merchantable pine overstory; (2) a study of prescribed burning and other treatments to favor the best of the present pine sprouts in small-size growth or, in the absence of promising sprouts, to convert to pine seedlings; and (3) continued tests of direct seeding and of silvicides.

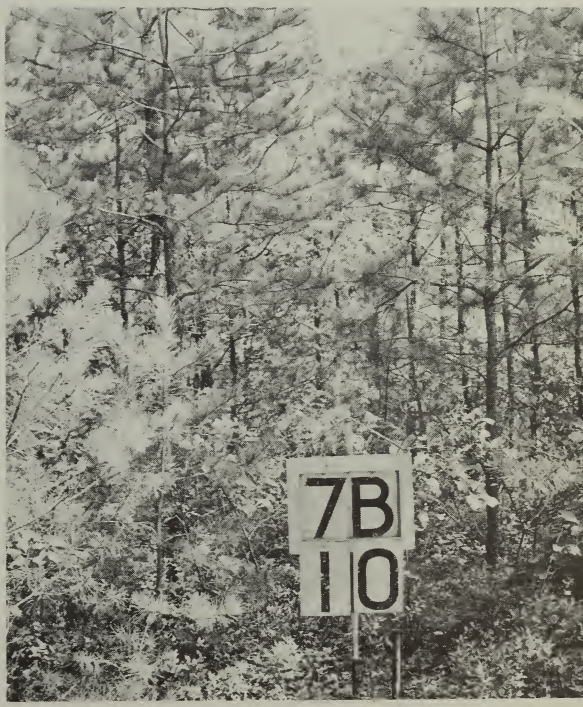
Figure 1. — How prescribed winter fires before cutting affect regeneration after cutting of an old oak-pine stand.

The original stand, unburned since the last wildfire.

The same area 6 years after the seed-tree cutting.



Part of the same general stand, but treated with annual prescribed burns for 10 years before cutting.



This same area 11 years after the seed-tree cutting.

Old-Field Pine Stands

Old-field pine stands tend to develop understories of tree oaks and hickories. If the understory is sparse, a few winter burns before cutting may so favor the establishment of pine seedlings that they will again predominate in the next stand. However, if no attempt has been made to control the hardwood understory until the overstory approaches maturity, an understory usually is so well established that it cannot be effectively thinned out and set back by prescribed winter burning before harvest cutting. About all that fire accomplishes under these circumstances is to prepare a seedbed and thus favor establishment of pine seedlings. Silvicides or other measures will be required to control the hardwoods and bring the pine seedlings through to dominance in the new stand *(9)*.

Whether periodic winter burning after pines are 15-20 years old will sufficiently check the trend to hardwoods so that continuous crops of pine are possible is not known, but is being studied.

Pine-Lowland Sites

Pine-lowland sites include the imperfectly to very poorly drained soils where pitch pine is the predominant overstory tree. These areas have dense, shrubby understories (fig. 3); some of the common shrubs, such as sheep-laurel and leatherleaf, are highly flammable.

Table 1. — *Pine reproduction in a pine-lowland area in relation to type of fire and site*

Type of fire	Seedlings per acre*			Quadrats stocked*		
	Wet lowland**	Medium lowland**	Dry lowland**	Wet lowland	Medium lowland	Dry lowland
	Number	*Number*	*Number*	*Percent*	*Percent*	*Percent*
None	67	0	67	3	0	3
Light	200	1,300	2,533	17	40	73
Severe	6,700	6,900	22,800	80	100	100

* Seedlings of the current year tallied in July of the first growing season after the fire *(12)*.

** Or, from left to right, very poorly drained, poorly drained, and imperfectly drained sites.

Figure 2. — A stand of pitch pine and scrub oaks shortly after the first prescribed winter fire. Periodic winter burns will kill back the scrub oaks, but these oaks will sprout vigorously.

To supplement burns of this type, possibly either repeated burns in late summer or early fall, or a mistblower application of silvicides, will be needed before harvest cutting if many of the scrub oaks are to be eliminated and the establishment and dominance of pine seedlings are to be favored.

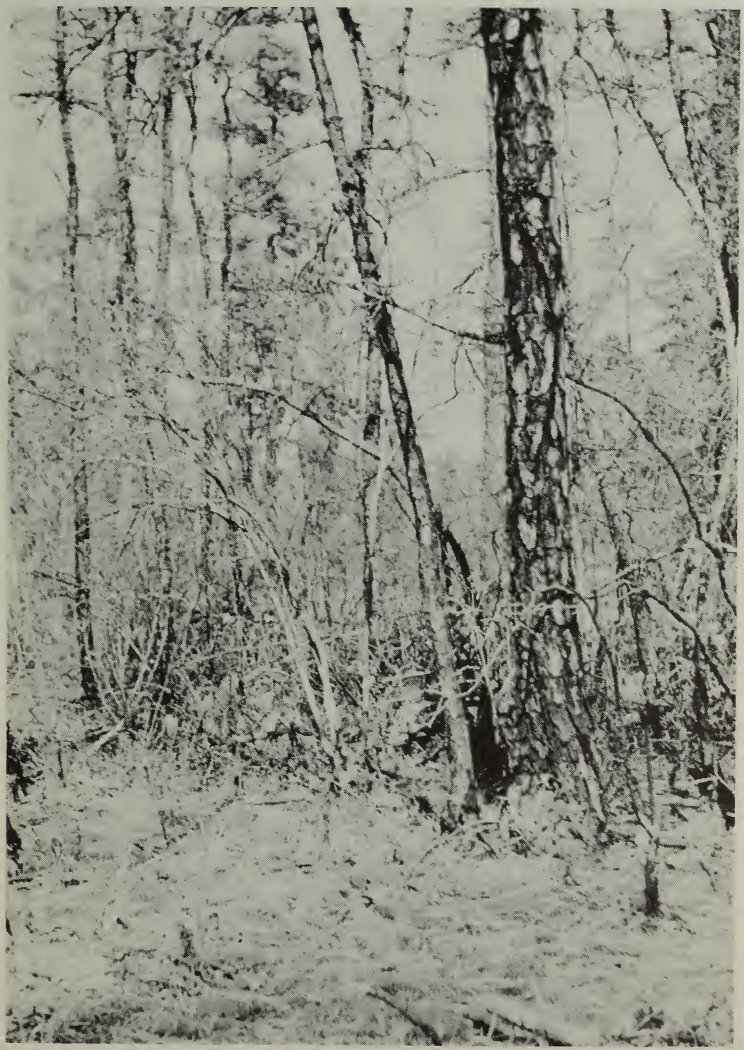
High fuel volumes, hotly burning shrubs, and relatively slow-drying forest floors make difficult the use of light winter fires under the stands. There is little leeway between the proper type of fire and one that crowns or at least scorches much of the overstory foliage. Consequently, light winter fires during the rotation are recommended only for preparing firebreaks.

However, pine is subclimax to hardwoods, and a severe disturbance is necessary to reproduce the more valuable pine. One very

An unburned stand on the wetter portion of these lowlands. Note the understory of red maple, blackgum, and many shrubs.

A similar stand, but burned by a relatively light fire the previous fall. Because this fire did not burn deeply enough to kill the root-collar buds, shrubs and hardwoods are sprouting vigorously.

Figure 3.—A typical pine-lowland site unburned for 25 years, and similar sites the first growing season after a fire in late summer or early fall.



A similar stand and site, but this one was burned during a drier period. Note the absence of sprouts.

hot, deep-burning fire in late summer or early fall, either just before or after a seed-tree cutting, can provide the desired results (fig. 3). Such a fire kills the buds of competing vegetation so it does not sprout, and leaves a favorable seedbed for pine seedlings. Lighter fires that consume only the litter and F-layer do not result in establishment of enough pine seedlings for full stocking (table 1), and they permit vigorous resprouting of shrubs and hardwoods (fig. 3). Of course, the desired type of fire is possible only in certain years, is relatively difficult to handle, and is as costly as several winter burns on upland sites *(3, 12)*.

White-Cedar Stands

Atlantic white-cedar stands occur on swamp sites, usually on peat soils. The only use of fire recommended here is for slash disposal shortly after clearcuttings.

These cuttings create large amounts of slash that may cover 40 to 50 percent of the area (fig. 4) and, where dense, form unsuitable conditions for white-cedar establishment. Even 5 or 6 years after cutting, slash-covered spots contain relatively few white-cedar seedlings — in one study only about 3 percent as many as occurred on slash-free spots *(2)*. Slash-covered spots become stocked chiefly by hardwood shrubs and sprouts. Consequently, if fully stocked stands of white-cedar are to regenerate after clearcuttings, disposal of the dense slash is essential.

Complete disposal of the slash is not necessary: a fire that consumes only the dead foliage and fine branches provides suitable conditions for white-cedar regeneration. Such a burn should be done when the peat is wet enough that it will not also be consumed. A satisfactory burn usually can be obtained without repiling the slash. Using this treatment in one study increased the proportion of 1/4-milacre quadrats subsequently stocked with white-cedar seedlings by 13 percent (from 72.5 to 86 percent). On many cuttings, however, the increase would be considerably greater: an appreciable part of the stand in this study area had been wind-thrown before the cutting, so much less slash was created than normally results.

Figure 4. — Slash left after cutting white-cedar trees. To regenerate this species, dense accumulations of slash should be burned, and residual hardwoods should be eliminated.

WILDFIRE PROTECTION

Much of the value from periodic winter burning of upland sites and of special firebreaks on lowland sites pays off in better protection against wildfires. Fuel reduction tends to lessen wildfire damage and to make suppression efforts easier and more effective. Of course, the extent of these effects varies — especially with the amount and continuity of fuel in prescribe-burned areas when the wildfire occurs, the moisture content of this fuel, and the extent to which living foliage is seared ahead of the wildfire *(15)*.

In spite of these variations, there have been notable instances of prescribed burning greatly facilitating suppression efforts and reducing wildfire damage *(4, 15)*.

Figure 5. — A loblolly pine-hardwood stand before and after a seed-tree cutting.

Top left: The stand before cutting.

Bottom left: Area burned in late summer after seed-tree cutting, as seen 8 years after fire. Note the good distribution and great amount of pine reproduction.

Below: A spot in the unburned portion that was little disturbed in logging. Here the advance growth of hardwoods captured the site. Where logging caused sufficient disturbance in other parts of the unburned plots, pine reproduction predominates.

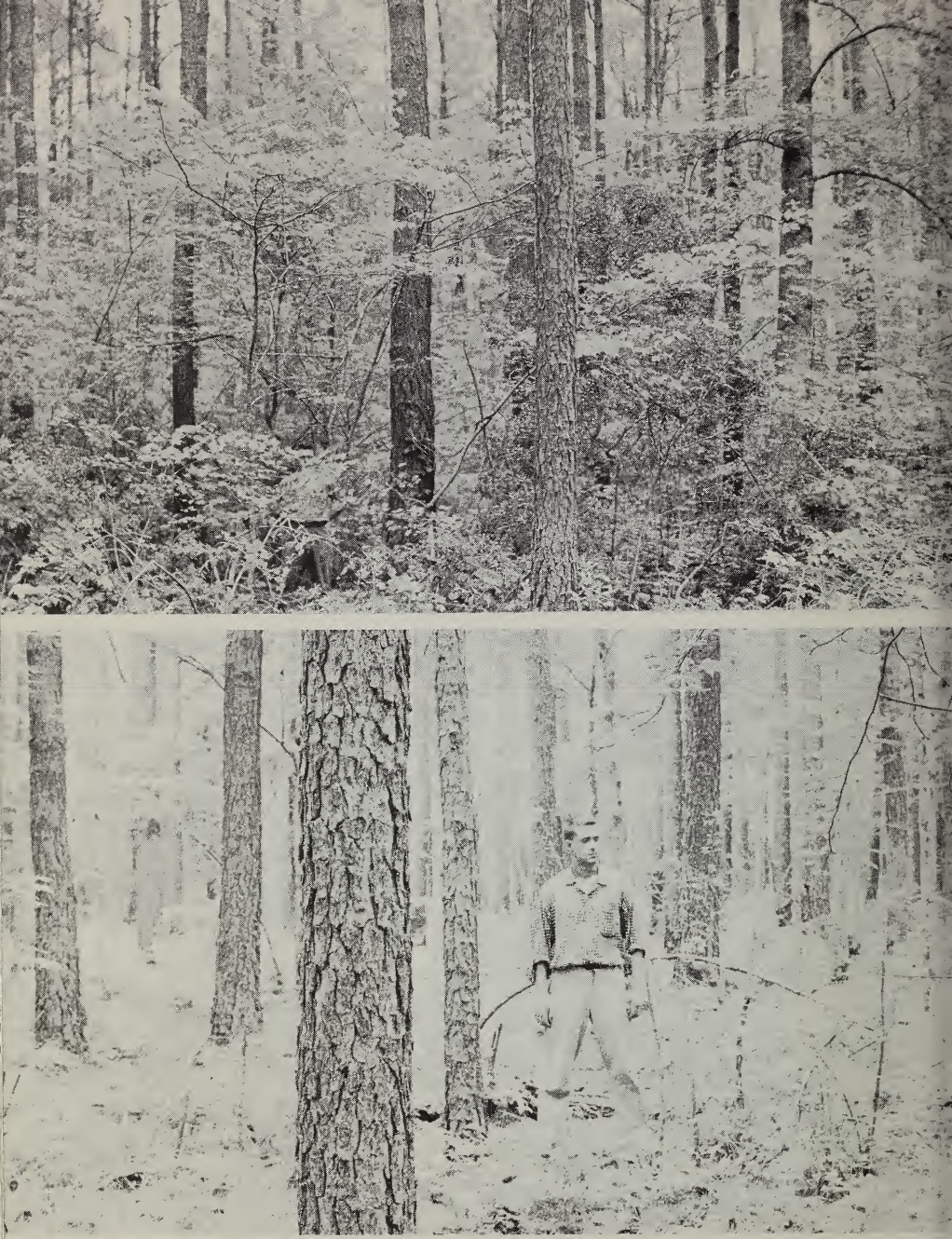


Figure 6. — Effect of two prescribed winter fires on the hardwood understory of a loblolly pine stand. Top: the unburned stand. Bottom: part of the burned portion.

ON MARYLAND'S EASTERN SHORE

On the Eastern Shore there is little need to use prescribed burning for wildfire protection in the lower counties, and its silvicultural role is not yet well defined.

However, one study did show that a hot fire in September after a seed-tree cutting greatly favored the establishment of another pine stand *(7)*. After 5 years the burned areas had more than twice as many pines equal or taller in height than competing hardwoods as did the unburned areas (fig. 5). Of course, such a fire is possible only in dry periods, and it should be used only in years when fair or better crops of pine seed will soon mature *(8)*. Observations of other similar prescribed burns on the Eastern Shore indicate that, as on New Jersey pine-lowland sites, the deeper the fire burns, the more it reduces sprouting of hardwoods and shrubs.

Loblolly is a more vigorous competitor in some respects than pitch or shortleaf pine. Possibly because the seeds are larger, loblolly seedlings will start on relatively thick forest floors, and they grow appreciably faster than those of pitch and shortleaf pines *(3)*. Consequently, for loblolly, less seedbed preparation and less control of competing vegetation seem necessary. Even single hot fires that did not burn particularly deep have sometimes favored the dominance of loblolly pine in the next stand.

The role of light winter fires under pine stands is still being studied. Apparently their use to establish advance pine reproduction before harvest cutting may not be of much value because of extensive damages done to pine reproduction in logging.

This conclusion is based on one study during which a commercial seed-tree cut, removing about 150 pines 8-22 inches d.b.h. per acre, eliminated nearly all the advance reproduction. In this study, the establishment of advance reproduction had been encouraged by prescribed winter burns in 1953 and 1956, and by shelterwood cutting in 1957. The latter involved a pulpwood cutting of pines

mostly under sawtimber size and the poisoning of hardwoods 3 inches d.b.h. and larger. The amount of advance pine reproduction before and after the seed-tree cutting (in 1958-59) was as follows for different pre-cutting treatments:

Treatment	*Pine seedlings per acre*		
	Before cutting	*After cutting*	*One growing season later*
Prescribe-burned and shelterwood-cut	6,517	500	283
Shelterwood-cut	2,633	117	67
Prescribe-burned	2,133	100	0
None	1,033	33	33

Just how effectively light winter fires will control the development of hardwood understories also is problematical, and is the subject of study. In a 4-year period of one study, the number of hardwoods larger than 0.5 inch d.b.h. increased by 8 percent in the unburned plots, but decreased by 65 percent in plots burned twice by light fires (fig. 6). Among the smaller hardwoods, however, new seedlings and sprouts just about balanced mortality, and little change in numbers occurred as a result of the burning treatments.

Experience to date with prescribed burning on the Eastern Shore indicates that light winter fires could be used advantageously, in conjunction with other treatments, to favor loblolly pine. For example, two winter fires followed by poisoning of the surviving hardwoods prior to harvest cutting should greatly favor establishment of pine seedlings and their subsequent dominance in the new stand. Fire may also be used as pre-conditioning for cultural measures — such as reducing the amount of slash in recently cut-over areas to facilitate planting, or reducing the volume of litter, shrubs, and small hardwoods to increase the efficacy of disking.

RESEARCH NEEDED

Even though much information has been obtained on the role of prescribed fires, additional information is needed to provide:

- Accurate guides for determining when to burn a specific type of

stand to obtain a given type of fire. Techniques of burning have been worked out fairly satisfactorily *(4, 5)*, but neither a sufficiently accurate burning index nor a guide for relating burning index to type of stand is available.

- An evaluation of the long-term effects of prescribed fire (used according to current recommendations) on stand growth and yields. Some short-term effects on New Jersey stands have been published *(16, 17)*.

- An evaluation of the long-term effects of prescribed fire, in combination with other management measures, on forest soils; and comparisons of these effects with those produced by alternative management methods. Some relatively short-term effects on upland sites in New Jersey have been studied *(1)*.

The possible use of summer or early-fall fires under stands also should be investigated. In the South, Lotti *(14)* and others have found repeated summer fires to be far more effective in eliminating understory hardwoods than repeated winter fires. In view of this finding, the effect of one winter fire to reduce fuels, followed by annual or biennial burns in summer or early fall, seems worthy of trial in the pine-hardwood stands of New Jersey and Maryland.

Once the specific effects of different types of prescribed fire in different forest situations have been determined, burning should be compared with other possible methods for accomplishing the same results. The comparisons should be in terms of costs, efficiency, convenience of application, and overall influence on growth, yield, and quality of treated stands.

SUMMARY

In southern New Jersey, prescribed burning has proved of value in both silviculture and wildfire protection. Its silvicultural role varies with stand conditions: different types and periodicities of fire are recommended for oak-pine stands, pine-lowland stands, and Atlantic white-cedar swamps.

Prescribed burning plays a less important role on the Eastern Shore of Maryland; there it ranks only as one of several tools that may be used in managing loblolly pine-hardwood stands. However, in this section too, both light winter fires under stands and single, relatively hot fires at the end of a rotation can be advantageously used under proper conditions.

Although much progress has been made in defining the role of fire, additional information is necessary before prescribed burning can be fitted into its proper place in the forest management of the two regions. This needed information includes better guides for when to burn, better evaluations of long-term effects of fire on stand yields and on soils, and economic comparisons with other possible methods of doing the same jobs.

LITERATURE CITED

(1) Burns, P. Y.
1952. Effect of fire on forest soils in the pine barren region of New Jersey. Yale Univ. School Forestry Bul. 57. 50 pp., illus.

(2) Little, S.
1950. Ecology and silviculture of whitecedar and associated hardwoods in southern New Jersey. Yale Univ. School Forestry Bul. 56. 103 pp., illus.

(3) ————————
1953. Prescribed burning as a tool of forest management in the northeastern states. Jour. Forestry 51:496-500.

(4) ———————— Allen, J. P., and Moore, E. B.
1948. Controlled burning as a dual-purpose tool of forest management in New Jersey's pine region. Jour. Forestry 46:810-819, illus.

(5) ———————— Allen, J. P., and Somes, H. A.
1948. More about the technique of prescribed burning. Northeast. Forest Expt. Sta. 4 pp.

(6) ———————— Cranmer, C. B., and Somes, H. A.
1958. Direct seeding of pitch pine in southern New Jersey. Northeast. Forest Expt. Sta., Sta. Paper 111. 14 pp., illus.

(7) ———————— and Mohr, J. J.
1954. Reproducing pine stands on the eastern shore of Maryland. Northeast. Forest Expt. Sta., Sta. Paper 67. 11 pp.

(8) ———————— and Mohr, J. J.
1957. Seedbed treatment increases dominance of natural loblolly pine reproduction. Northeast. Forest Expt. Sta. Forest Res. Note 76. 4 pp.

(9) ———————— and Moore, E. B.
1949. The ecological role of prescribed burns in the pine-oak forests of southern New Jersey. Ecology 30:223-233, illus.

(10) ———————— and Moore, E. B.
1950. Effect of prescribed burns and shelterwood cutting on reproduction of shortleaf and pitch pine. Northeast. Forest Expt. Sta., Sta. Paper 35. 11 pp.

(11) ———————— and Moore, E. B.
1952. Mechanical preparation of seedbeds for converting oak-pine stands to pine. Jour. Forestry 50:840-844, illus.

(12) ———————— and Moore, E. B.
1953. Severe burning treatment tested on lowland pine sites. Northeast. Forest Expt. Sta., Sta. Paper 64. 11 pp.

(13) ———————— and Somes, H. A.
1956. Buds enable pitch and shortleaf pines to recover from injury. Northeast. Forest Expt. Sta., Sta. Paper 81. 14 pp., illus.

(14) Lotti, T.
1956. Eliminating understory hardwoods with summer prescribed fires in coastal plain loblolly pine stands. Jour. Forestry 54: 191-192, illus.

(15) Moore, E. B., Smith, G. E., and Little, S.
1955. Wildfire damage reduced on prescribe-burned areas in New Jersey. Jour. Forestry 53:339-341, illus.

(16) Somes, H. A., and Moorhead, G. R.
1950. Prescribed burning does not reduce yield from oak-pine stands of southern New Jersey. Northeast. Forest Expt. Sta., Sta. Paper 36. 19 pp.

(17) ———————— and Moorhead, G. R.
1954. Do thinning and prescribed burning affect the growth of shortleaf pine? Northeast. Forest Expt. Sta., Forest Res. Note 34. 2 pp.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